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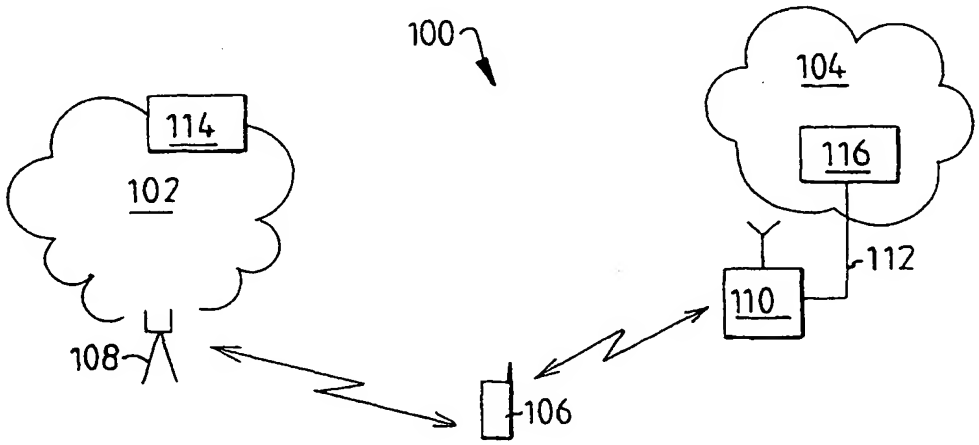
(54) Title: A SYSTEM AND A METHOD FOR PROVIDING TELECOMMUNICATION SERVICES OVER EITHER A FIXED NETWORK OR A MOBILE NETWORK DEPENDING ON THE LOCATION OF THE MOBILE TERMINAL



(57) Abstract: A system and method for routing a telephone call, wherein a mobile terminal (106) is used as a combined cordless telephone and a mobile telephone. The system automatically takes care of roaming between a mobile network (102) and a fixed network (104). The call will be connected over either the fixed network (104) or the mobile network (102) depending on whether the mobile terminal (106) is within or out of radio coverage of a home base station (110) connected to the fixed network (104). The call is routed in response to a routing indication which is included in the called number of the mobile terminal (106) depending on the location of th emobile terminal (106). In this way, network operators may direct calls over the fixed network (104) in preference to the mobile network (102), thereby providing higher quality to subscribers and a simpler infrastructure of the mobile network (102).

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A SYSTEM AND A METHOD FOR PROVIDING TELECOMMUNICATION SERVICES OVER EITHER A FIXED NETWORK OR A MOBILE NETWORK DEPENDING ON THE LOCATION OF THE MOBILE TERMINAL

TECHNICAL FIELD

The present invention relates to a system and method for providing telecommunication services to a subscriber using a mobile terminal. In particular, telecommunication services are provided over either a fixed network or a mobile network depending on the location of the mobile terminal.

BACKGROUND OF THE INVENTION AND PRIOR ART

Today, there is a rapid increase in the building of new mobile telecommunication networks, such as GSM (Global System for Mobile communication) networks.

A cellular mobile network typically includes a plurality of base stations being connected together by means of switching nodes such as a Base Station Controller (BSC) and/or a Mobile Switching Centre (MSC). Each base station provides radio coverage over an area known as a cell for radio communication with mobile phones located therein. Each of the base stations and the mobile phones include, among other things, a transceiver for radio communication over radio frequency channels. Each mobile network is allocated by licence a certain limited radio frequency band spectrum for transmissions, and efforts are made by network operators to provide the greatest possible traffic capacity within the allocated frequency band. In other words, the operators attempt to maximise the number of possible ongoing call connections within the limits of the available radio channels.

Mobile networks are built and operated by different operators who have been awarded a licence for a particular frequency band. However, the different frequency bands allocated to the

operators are a limited resource for which a licence may be very costly to obtain, at least in some countries.

As mentioned above, operators of mobile networks are usually faced with the problem of how to utilise their frequency band in the most efficient way once the licence has been obtained. Furthermore, some of the operators also own and control a fixed telecommunication network.

When communicating over a fixed network, unlicensed cordless radio technology may be used for so-called cordless phones. A Home Base Station (HBS) is then connected to the fixed network for providing a cordless radio interface between a fixed line of the fixed network and the cordless phone. The cordless phone may be used in a limited area of radio coverage from the HBS using a suitable short distance radio interface, such as Bluetooth, DECT or CT2. Both the HBS and the cordless phone include a transceiver for radio communication over a particular frequency band for which no licence is required.

An operator operating both a fixed network and a mobile network can benefit if more telecommunication traffic is transmitted via the fixed network instead of over the mobile network. It would then be possible to design larger cells in the mobile network without having traffic congestion in the cells. This is of particular interest in dense areas such as cities. The cost for network infrastructure is thereby reduced and cell planning is facilitated for the operator. Using only one mobile terminal for communication over both the fixed and the mobile network, having a single telephone number, would be a great benefit for subscribers. Moreover, if the fixed network can be used in preference to the mobile network, the cost for making calls may also be reduced for subscribers. Further, it would be highly desirable for operators to offer a

combined subscription for both mobile and fixed telecommunication to subscribers, involving unified charging among other things.

SUMMARY

It is an object of the present invention to overcome the problems as outlined above by providing a method and a system optimising the use of a fixed network and a mobile network, for an operator having control of both.

This object and others are obtained by a system and a method wherein subscribers are able to use a mobile terminal which is a combined cordless phone and a mobile phone. The terms "cordless phone" and "mobile phone" are here used to distinguish between unlicensed cordless radio technology and licensed cellular mobile network technology. The "cordless" part of the terminal may operate by using any suitable short distance radio interface, such as according to the Bluetooth, DECT or CT2 standards. The "mobile" part of the terminal may operate using any cellular mobile communication standard, such as the GSM standard. The present invention is thus not limited to any particular cordless and mobile technologies or standards.

The present invention provides functionality which automatically takes care of roaming between the mobile network and the fixed network. Thus, when the user is out of radio coverage of an HBS using the cordless radio interface, the user will receive and make calls over the mobile network. On the other hand, when the user is within the cordless radio coverage, he/she will be called and make calls over the HBS and the access line of the fixed network. The HBS is capable of detecting whether the mobile terminal is within its radio coverage, and of updating the telecommunication system when

the mobile terminal moves in and out of the radio coverage. The routing of calls is performed in response to a routing indication which is included in the called number of the mobile terminal depending on the location of the mobile terminal relative the radio coverage of the HBS.

Some further benefits for the subscribers are that better quality is obtained over the HBS and the fixed network, and that the battery consumption in the mobile is reduced. The cost for making calls over the fixed network is also generally lower. The benefits for the operator are that existing infrastructure may be re-used, and that larger cells can be built, since it is possible to direct mobile calls through the fixed network instead of the mobile network. Also, if the fixed line, such as a PSTN or ISDN line, of a subscriber is busy, an incoming call can be re-routed over the mobile network.

Additional advantages include that the subscribers telephone number can be maintained or only slightly changed, such as by adding a suffix or a prefix. Also, calling number presentation will be maintained, since the same number is used when calling over either the mobile network or the fixed network.

Furthermore, users will be able to roam into other networks, e.g., GSM based networks, outside his own country, thereby providing a mobile terminal capable of global use.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in more detail with reference to the accompanying drawings, in which:

Fig. 1 is a general view of a combined mobile and fixed network.

Fig. 2 is a schematic view of a network configuration in which the invention may be implemented.
Figs. 3a, 3b are schematic views of a network configuration according to one aspect of the invention.
Fig. 4 is a schematic view of a network configuration according to another aspect of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

In the following exemplary embodiments, the cordless radio interface between the fixed network and the combined cordless and mobile telephone is assumed to be a Bluetooth based interface. However, as stated above, any suitable short distance radio interface, such as a DECT interface or a CT2 interface, may be used instead for connection between the cordless telephone and the fixed network.

With reference to Fig. 1, a combined telephone network 100 comprises both a mobile network 102, such as a GSM network, and a fixed network 104, such as a Public Switched Telephony Network (PSTN), for providing telecommunication for a mobile terminal 106. The mobile network 102 includes base stations 108 for providing an interface between the mobile terminal 106 and the mobile network 102. For the sake of simplicity, only one base station 108 is shown in Fig. 1. A fixed subscription line 112 of the fixed network 104 is connected to a Home Base Station (HBS) 110 for providing an interface between the mobile terminal 106 and the fixed network 104. The HBS 110 may be capable of having several mobile terminals or cordless phones, not shown, associated therewith. Furthermore, the mobile terminal 106 used in this example is capable of connecting both to the HBS 110 providing the cordless interface, and the mobile network 102.

If the mobile terminal 106 is located within the cordless radio coverage of the HBS 110, all incoming and outgoing calls are routed over the HBS 110 of the fixed subscription line 112, using the cordless radio interface. On the other hand, if the mobile terminal 106 is located out of radio coverage of the HBS 110, the calls are routed over the base station 108 of the mobile network 102.

In accordance with the invention, the HBS 110 is capable of detecting whether the mobile terminal 106 is within the radio coverage of the HBS 110, and of informing the combined network 100 accordingly. Any previously known detection method may be used, which will not be described here further. Thus, apart from being capable of communication with both the HBS 110 and base stations 108 of the mobile network 102, there are no specific requirements on the mobile terminal 106, e.g., regarding functionality for selecting between the two interfaces.

When it is detected by the HBS 110 that the mobile terminal 106 enters into its radio coverage, the HBS 110 dials a specific code in order to update the telecommunication system. This code could be a normal forwarding code (e.g. *21*.....) or a specific number (e.g. 400 .....). A security code may also be appended to the dialled number in order to increase the security. Later, when the mobile terminal 106 exits from the radio coverage of the HBS 110, a similar procedure is performed for updating the telecommunication system accordingly.

According to one embodiment of the invention, the number dialled by the HBS 110 leads to the fixed network 104 and is interpreted such that the call ends up in an IN SSP (Intelligent Network Service Switching Point), not shown. In

response to the received call from the HBS 110, the IN SSP updates the location of the mobile terminal 106 in a location database of the fixed network 104, e.g., a Number Portability Database Cluster, not shown in Fig. 1.

Thus, when a call is made to the subscriber using the mobile terminal 106, the location database is queried to determine if the mobile terminal 106 is within or out of radio coverage of the HBS 110. According to the invention, a routing indication, such as a prefix, is added to the dialled number in response to the query. The routing indication is selected to indicate whether the mobile terminal 106 is within or out of radio coverage of the HBS 110. The routing indication added to the dialled number will then guide the call to either a Gateway Mobile Switching Centre (GMSC) 114 in the mobile network 102, or a Local Exchange (LE) 116 in the fixed network 104, depending on the location of the called mobile terminal 106 as indicated. Once the incoming call reaches the GMSC 114 or the LE 116, the routing indication will be removed from the dialled number. If the call reaches the LE 116, then the subscriber will be called immediately. If the call reaches the GMSC 114, a normal mobile call procedure, e.g., in accordance with GSM, is executed before the subscriber can be called.

In this inventive arrangement, the same telephone number will be valid in both the fixed network and the mobile network, thereby avoiding separate numbers for two subscriptions, which is an advantage to the subscriber. Further, calling line presentation will then work correctly in both mobile and cordless connections.

The technique as described herein can be gradually introduced in networks in different phases. Thus, in a first phase, the interrogation to a location database regarding the location of

a called mobile terminal is done late in the call chain, e.g., at the end LE. Then gradually, the interrogation can be done earlier in the call chain. With a high penetration of the service, it is advantageous to perform the interrogation early in order to use network trunks more efficiently.

Fig. 2 illustrates a network configuration where three different phases are indicated for introducing the present invention in an exemplary communication scenario. In this example, an HBS 110 of a subscriber B is connected to a PSTN access network 104. ISDN access may also be implemented using a similar technique or new and/or existing signalling could be used. The PSTN access network 104 includes a transit network 200 of interconnected Transit Exchanges (TEs) 202 to which a plurality of Local Exchanges (LEs) 204 are connected. the PSTN access network 104 is further connected to a location database 206, e.g., a Number Portability Database Cluster which in reality may comprise a plurality of data bases. A subscriber A is assumed to make a call to the subscriber B. In Fig. 2, interrogation to the location database 206 regarding the location of the mobile terminal 106 of the called subscriber B is indicated for different phases as phase 1 (PH1), phase 2 (PH2) and phase 3 (PH3), respectively.

Fig. 3a illustrates the routing of an incoming call from a subscriber A to a subscriber B having a mobile terminal 106, which is a combined cordless phone and a mobile phone according to, e.g., Bluetooth and GSM standards respectively. The mobile network 102 includes a GMSC 114, a Mobile Switching Centre (MSC) 208 and a Home Location Register (HLR) 210. In this case, the mobile terminal 106 is within radio coverage of the HBS 110.

Thus, when the call is routed to a TE 202a, a query 300 including the called number is sent to a location database 206 for checking if the mobile terminal 106 is within range of the HBS 110. The location database 206 replies by adding a routing indication R1, such as a prefix, to the called number. In this case, the routing indication R1 indicates that the mobile terminal 106 is within radio coverage of the HBS 110. The call is then routed from the TE 202a to the local HBS 110 of the subscriber B for connection to the mobile terminal 106. The routing indication R1 is removed from the called number before connecting to the mobile terminal 106, preferably when the call reaches the LE to which the HBS 110 is connected.

Fig. 3b illustrates the routing of an incoming call from a subscriber A to a subscriber B where the mobile terminal 106 is out of radio coverage of the HBS 110. Thus as in the previous example of Fig. 3a, it is first checked in the location database 206 if the mobile terminal 106 is within radio coverage of the HBS 110. In this case however, the location database 206 replies by adding a routing indication R2 to the called number which indicates that the mobile terminal 106 is out of radio coverage of the HBS 110. The call is then routed from the TE 202a to the GMSC 114 of the mobile network 102 and further over the MSC 208 and the base station 108 to the mobile terminal 106. The routing indication R2 is removed from the called number before connecting to the mobile terminal 106, preferably when the call reaches the GMSC 114.

In the examples of Fig. 3a and 3b, it is assumed that the HBS 110 constantly updates the location database 206 as described above each time the mobile terminal 106 moves in or out of radio coverage of the HBS 110.

According to an alternative embodiment of the invention, the HBS 110 constantly updates the HLR 210 in the mobile network 102 on the location of the mobile terminal 106 in relation to the radio coverage of the HBS 110. In this case, incoming calls to the mobile terminal 106 are first routed to the GMSC 114 which checks the current mobile terminal 106 location with the HLR 210.

In Fig. 4, the routing of a call to the mobile terminal 106 where the mobile terminal 106 is outside or inside HBS radio coverage, respectively, is illustrated.

Thus in this embodiment, a call to the mobile terminal 106 is first routed to the GMSC 114, which sends a query 400, including the called number, to the HLR 210 for checking the location of the mobile terminal 106 in relation to the HBS 110 radio coverage. The HLR 210 normally gives the GMSC 114 a roaming number. If the mobile is outside HBS coverage, the roaming number will point to an MSC 208 in a conventional manner. In this case, the roaming number can be said to already include a routing indication. However if the mobile is within HBS range, then a new roaming number is created by adding a routing indication, e.g., a prefix, to the ordinary telephone number, wherein the call is routed over the fixed network 104. The routing indication will then be removed from the telephone number, preferably by the LE to which the HBS 110 is connected, and connect the call to the mobile terminal 106 as described above.

To indicate roaming by the mobile terminal 106 in and out of HBS coverage, the HBS 110 will use the same procedure as described above for the first embodiment, but instead of updating the location database 206, such as a number portability database cluster by means of the IN SSP, it will

update the HLR 210, preferably using an Intelligent Network Application Protocol (INAP) interface.

However, the rest of the network components may be standard components and it is not required to implement support for Number portability in the GMSC. Optimised routing is also possible, since the HLR inquiry may be performed from any GMSC.

Furthermore, using the embodiments of the invention as exemplified above enables that the same number is used in the GSM network as in the fixed network, which is a simple way to support a coherent calling line presentation for calls from a mobile terminal. This is also a great advantage since many subscribers are reluctant to change their phone numbers. Further, if there are more people in a family, each individual may be differentiated by a slight variation of the telephone number, such as a suffix. Possibly a user of this service could get a new prefix. The old number (including area code) can still lead to home.

For example, if a family's current fixed home phone number is X, the fixed home phone will still be reached on this number. In addition to the fixed home telephone number, family members can be equipped with a wireless handset, for example a combined GSM and Bluetooth telephone. Individual family members are reached on their individual handsets for example by adding a suffix to X, thus X+n where n={1,2,3...9}. n=0 may be used as an alternative to indicate the fixed home phone.

Using the invention as described herein will achieve a number of advantages compared to conventional network solutions. Thus, the use of an existing fixed network can be optimised in combination with a mobile network. Further, the inventive

solution makes it possible for subscribers to maintain their old telephone number, and calling number presentation which is a commonly used function will work globally, since the same number is used both in the fixed network and the mobile network.

While the invention has been described with reference to specific exemplary embodiments, the description is only intended to illustrate the inventive concept and should not be taken as limiting the scope of the invention. Various alternatives, modifications and equivalents may be used without departing from the spirit of the invention, which is defined by the appended claims.

CLAIMS

1. A telecommunication system comprising a fixed telecommunication network, a mobile communication network and a home base station connectable to the fixed network for providing a cordless short distance radio interface between a mobile terminal and the fixed network, wherein the home base station comprises:

- means for detecting whether the mobile terminal is within radio coverage of the home base station, and
- means for updating the telecommunication system when the mobile terminal moves in and out of the radio coverage,

characterised by:

means for routing telephone calls to the mobile terminal via the home base station when the mobile terminal is within radio coverage of the home base station, and via the mobile network when the mobile terminal is out of radio coverage of the home base station, in response to a routing indication which is included in the called number of the mobile terminal depending on the location of the mobile terminal relative the radio coverage of the home base station.

2. A system according to claim 1, **characterised in** that the telecommunication system is updated by using a dialled number.

3. A system according to claim 1 or 2, **characterised in** that information if the mobile terminal is within coverage or not is stored in a location database of the fixed network.

4. A system according to claim 3, **characterised in** that the routing indication is added to the called number by the location database upon query in connection with an incoming call.

5. A system according to claim 2, **characterised in** that the information if the mobile terminal is within coverage or not is stored in a Home Location Register of the mobile network.

6. A system according to claim 5, **characterised in** that the routing indication is added to the called number by the Home Location Register if the mobile terminal is within radio coverage of the home base station upon query in connection with an incoming call.

7. A system according to claim 5, **characterised in** that the routing indication is included in a roaming number given by the Home Location Register if the mobile terminal is out of radio coverage of the home base station upon query in connection with an incoming call.

8. A system according to any of claims 1 - 7, **characterised in** that the routing indication is removed from the called number before connecting to the mobile terminal.

9. A method of routing a telephone call in a telecommunication system comprising a fixed telecommunication network, a mobile communication network and a home base station connectable to the fixed network for providing a cordless short distance radio interface between a mobile terminal and the fixed network, wherein the home base station detects whether the mobile terminal is within radio coverage of the home base station, and updates the telecommunication system when the mobile terminal moves in and out of the radio coverage, **characterised by** the step of:
routing the telephone call to the mobile terminal via the home base station when the mobile terminal is within radio coverage of the home base station, and via the mobile network when the

mobile terminal is out of radio coverage of the home base station, in response to a routing indication which is included in the called number of the mobile terminal depending on the location of the mobile terminal relative the radio coverage of the home base station.

10. A method according to claim 9, **characterised by** the further step of updating the telecommunication system by using a dialled number.

11. A method according to claim 9 or 10, **characterised by** the further step of storing information if the mobile terminal is within coverage or not in a location database of the fixed network.

12. A method according to claim 11, **characterised by** the further step of adding the routing indication to the called number by the location database upon query in connection with an incoming call.

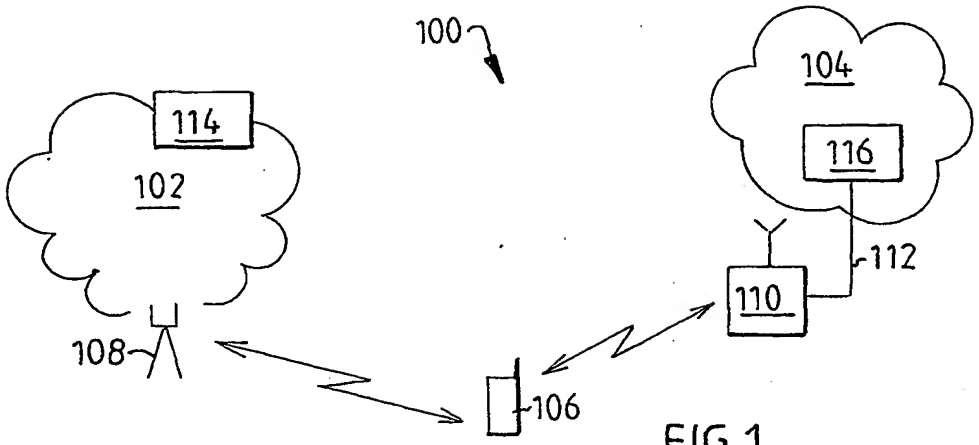
13. A method according to claim 10, **characterised by** the further step of storing the information if the mobile terminal is within coverage or not in a Home Location Register of the mobile network.

14. A method according to claim 13, **characterised by** the further step of adding the routing indication to the called number by the Home Location Register if the mobile terminal is within radio coverage of the home base station upon query in connection with an incoming call.

15. A method according to claim 13, **characterised by** the further step of including the routing indication in a roaming number given by the Home Location Register if the mobile

terminal is out of radio coverage of the home base station upon query in connection with an incoming call.

16. A method according to any of claims 9 - 15, **characterised by** the further step of removing the routing indication from the called number before connecting to the mobile terminal.


100
104
116
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102
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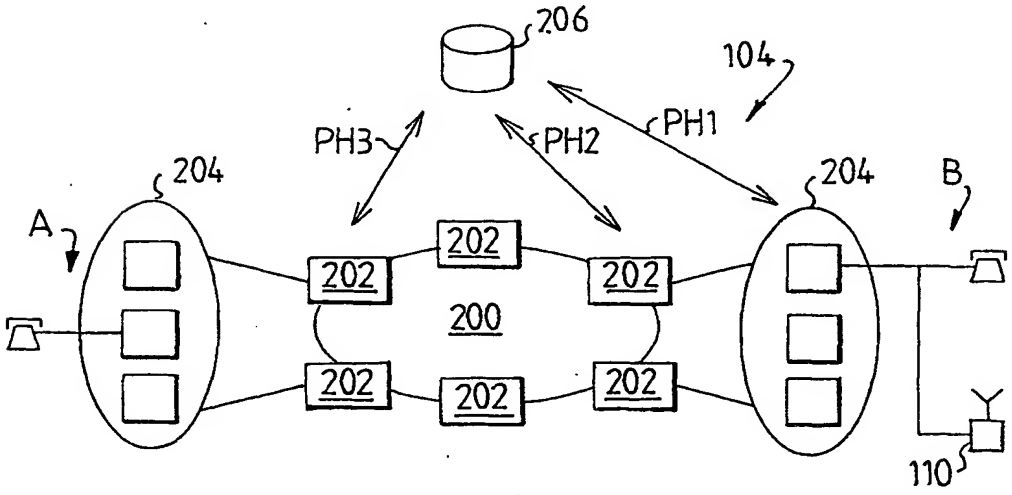
106

FIG.1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PH2
PH1
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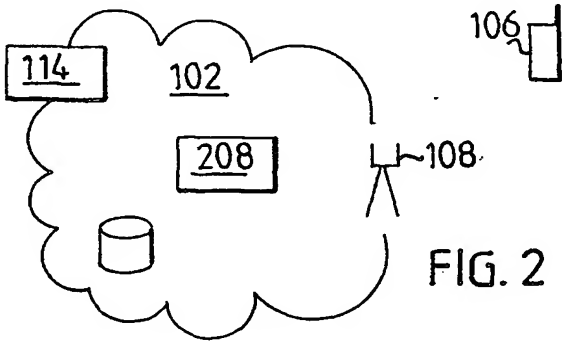
110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108

FIG. 2

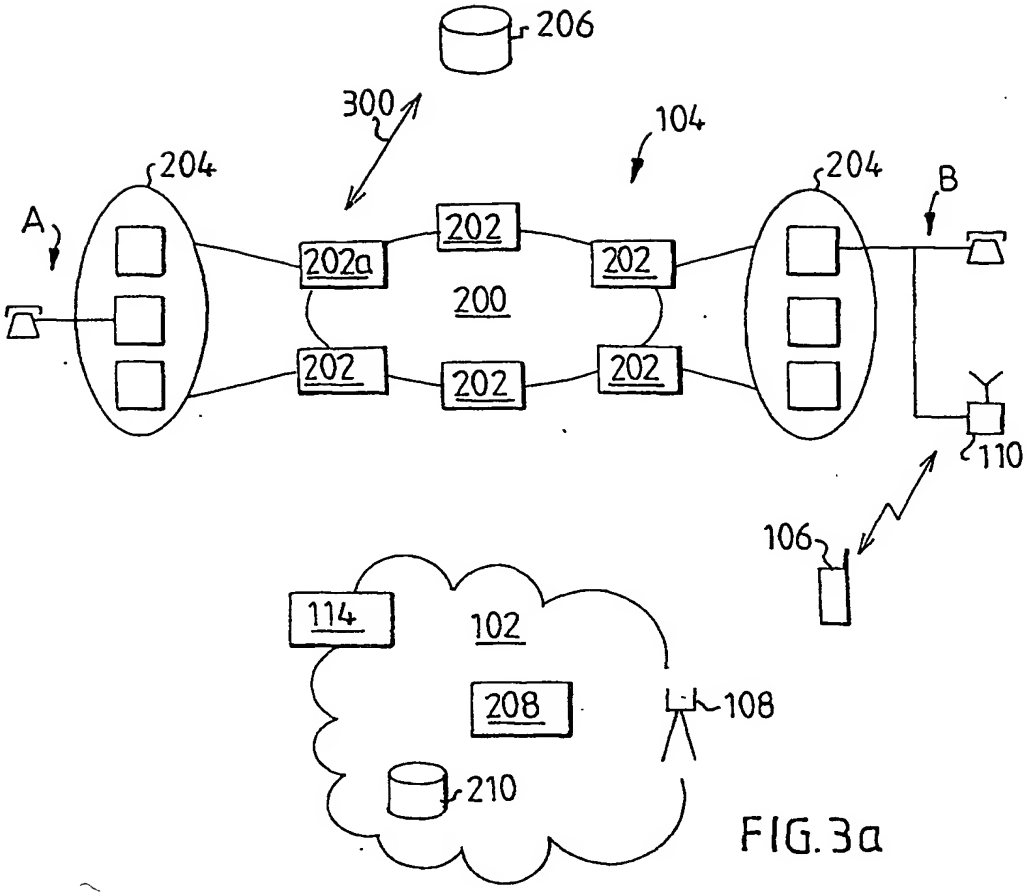
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FIG.3a

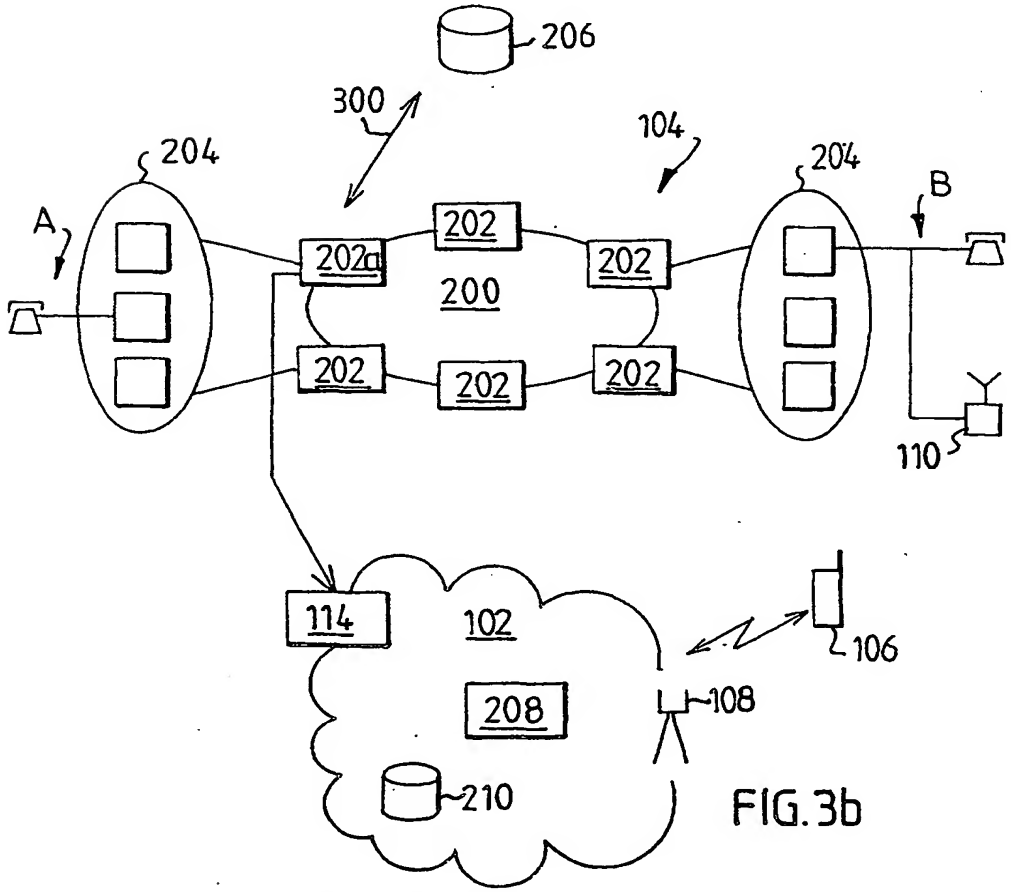
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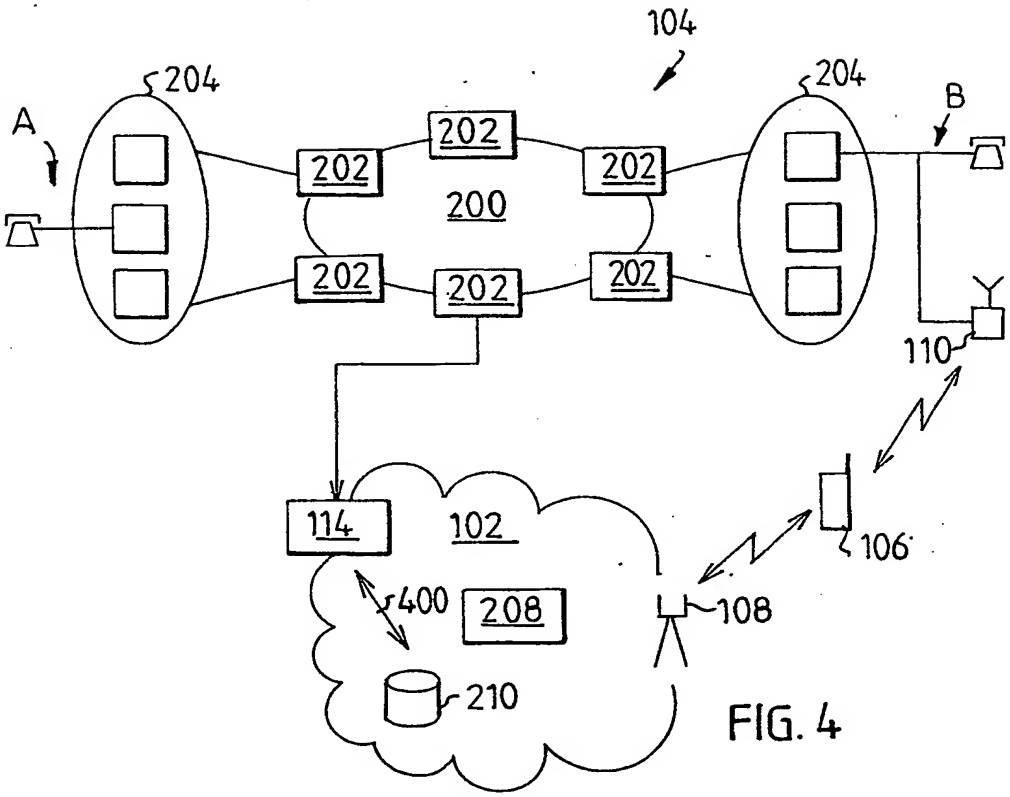
FIG.3b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210

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01857

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/32, H04Q 7/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5664005 A (EMERY ET AL), 2 Sept 1997 (02.09.97), column 7, line 56 - column 9, line 15; column 15, line 47 - column 17, line 6, figures 3,4, claim 21, abstract --	1-16
X	US 5353331 A (EMERY ET AL), 4 October 1994 (04.10.94), column 7, line 28 - column 9, line 43; column 17, line 13 - column 18, line 46; column 21, line 14 - column 22, line 15, figures 3-5, claims 4,5, abstract --	1-16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2001	04 -12- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Stefan Hansson/js Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01857

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 0008880 A1 (U S WEST, INC.), 17 February 2000 (17.02.00), page 3, line 15 - page 7, line 24; page 15, line 17 - page 17, line 7; page 23, line 4 - page 24, line 14, figures 1-3, claims 1-3, abstract --	1-16
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